ASCI PathForward Project

PathForward Project

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A PathForward Strategy

Build future high end computing systems from building blocks (hardware and software) created to address the commodity computing marketplace.

- concentrate investments (which are small compared to the commodity marketplace R&D) very carefully in those areas (hardware and software) which will enable commodity systems to be scaled-up to satisfy high-end computing requirements

PathForward Project

"Establish multi-year development and engineering efforts to create the critical integrating and scaling technologies required for balanced computing environments at the scale of 10 to 30 TeraFLOPS (TFLOPS) in the late 1999 to 2001 timeframe."

Balanced "Ultra-Scale" Computing

- Balanced systems at 10 -100 TFLOPS scale place stringent requirements on the internode interconnect, I/O and storage subsystems, distributed system software, and programming environment.

- ASCI balanced systems ratios (hardware):

  1 TeraFLOPS peak performance /

  1 Terabyte memory size / 50 Terabyte disk storage /

  16 Terabyte per second cache bandwidth / 3 Terabyte per second memory bandwidth /

  0.1 Terabyte per second I/O bandwidth / 10 Gigabyte per second disk bandwidth /

  1 Gigabyte per second archival storage bandwidth /

  10 Petabyte archival storage.

In scaling up over several orders of magnitude, these requirements will be difficult to achieve.

PathForward Project: Development and Engineering Opportunities

- To achieve balanced, high-end, scientific computing at 10 TFLOPS and beyond,
- that can be made available on a time scale sufficiently rapid to impact future ASCI platform and subsystem procurements--notably 30 TFLOPS in the 2001 timeframe,
- that will accelerate extended capabilities of commercial product lines to market, and
- will not be created by commercial market forces in the time scale of interest.

PathForward has a strategic focus

- extends beyond enhancement of existing platforms
- should impact multiple ASCI applications
- seeking widest possible impact on ASCI systems
  - software usable on multiple platforms
  - hardware impact on multiple generations

PathForward Critical Technology Areas

- Finite Phase 1 funding limits our current scope to the most critical technologies
- Critical technology areas were identified in a preliminary exercise
- These are documented in the PathForward Project Description
- This is available at http://www.llnl.gov/asci-pathforward

PathForward
Critical Technology Areas

- **Scaleable High-Performance Interconnects**
- **Distributed Parallel Operating System Software**
- **Parallel Scaleable Programming Environment**
- **Ultra-Scale, High-Performance Storage**

ASCI hardware requirements

Level	Effective Latency (CPU cycles)	Bandwidth (Random read/write)	Size	
On-chip cache**, L1	2-3 ●	16-32 B/cycle ●	10^{-4} B/flop * ● ↑	
Off-chip cache**, L2 (SRAM)	5-6 ●	16 B/cycle ●	10^{-2} B/flop * ● ↑	
Local main memory (DRAM)	30-80 (15-30) ↓	2-8 B/flop pk (2-8 B/flop sustained) ↓	1 B/flop ● ↑	Compute engine
"nearby nodes"	300-500 (30-50) ↓	1-8 B/flop (8 B/flop) ↓	1 B/flop ●	Interconnect
"far away nodes"	1000 (100-200) ↓	1 B/flop (1 B/flop) ↓	1 B/flop ●	
I/O (memory disk)	10 ms ●	0.01-0.1 B/flop ●	10-100 B/flop ●	
Archive (disk-tape)	Seconds ●	10^{-4} B/flop (0.001-0.01 B/flop) ↓	10^{2} B/flop 10^{4} B/flop ↓	
User access	1/10 s (1/60 s)	OC3/desktop (OC12-48 /desktop) ↓	100 users ●	
Multiple sites	1/10 s ●	●	●	

* Equivalent integer and floating-point data calculation rates are required.
** Cacheless systems with equivalent performance are fully acceptable.

Primary investment priority

Secondary investment priority

1996-1998 Situation

(1998-2000 Requirements)

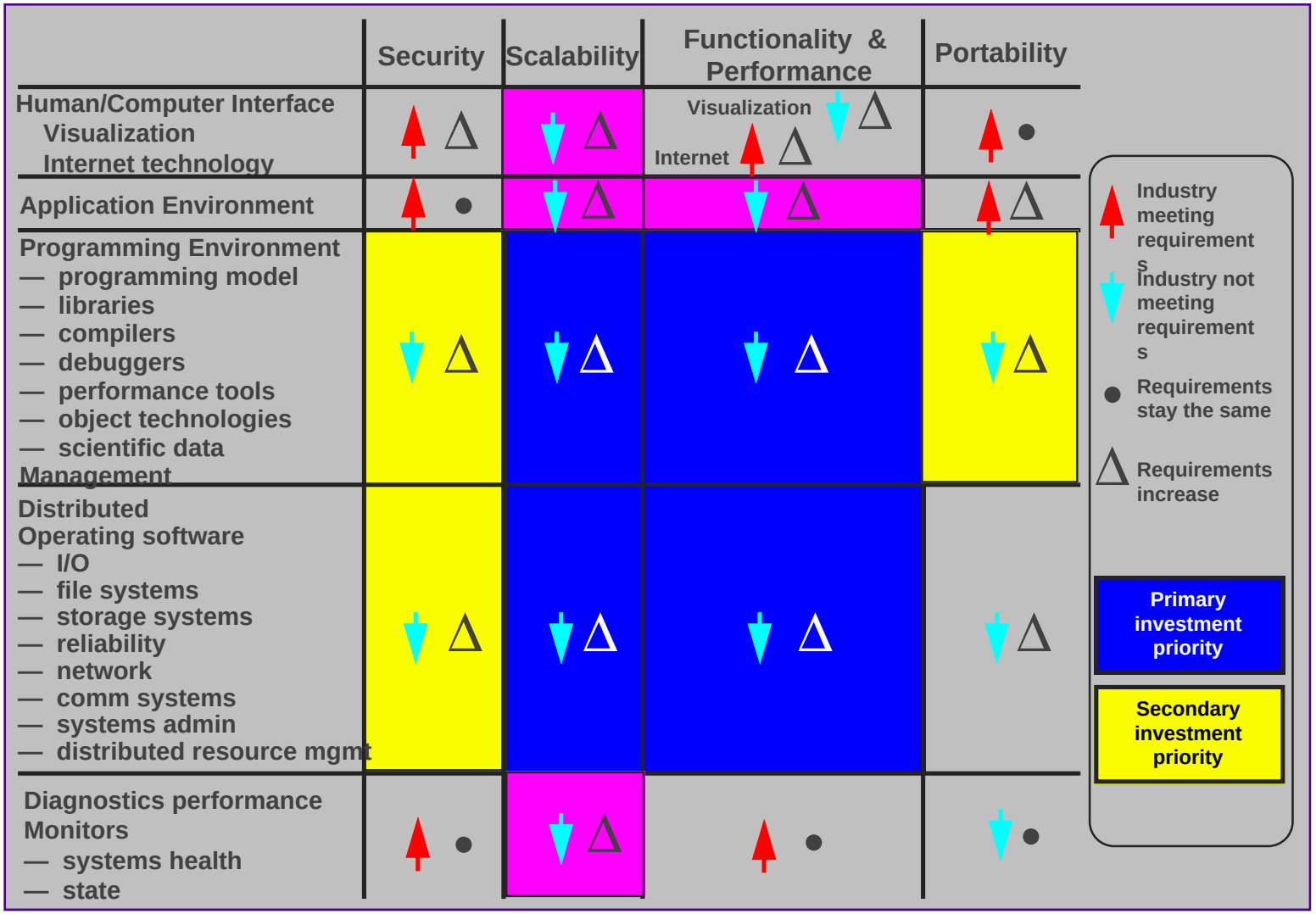
Industry Trend

↑ Industry gets better at meeting requirements

↓ Industry gets worse at meeting requirements

● Industry continues to meet requirements

ASCI software requirements



We welcome your feedback

- We welcome feedback and suggestions for additional technology focus areas
- PathForward scope is potentially broader than outlined in the Project Description
- We anticipate multiple iterations and interactions with companies in the course of establishing PathForward development activities

PathForward HomePage

- ASCI PathForward Project Overview
- Request For Expression of Interest
- PathForward Project Description

  This document describes the goals and technical rationale of the PathForward Project.
- ASCI PathForward Project Meeting

  This document announces a Project Meeting being held on January 16, 1997.
- ASCI homepage

  This webpage contains links to other ASCI projects and issues.
- ASCI Program Plan

  This document provides a global overview of the ASCI program.
- Frequently Asked Questions (FAQ)